FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL MODEL 1761 MARK-3

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•Your Local Agent/Dealer

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MODEL 1761 MARK-3

(YOSH)

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⚠ SAFETY INSTRUCTIONS

⚠ DANGER

Stay away from transmitting antenna.

The radar antenna emits microwave radiation which can be harmful to the human body, particularly the eyes. Never look directly into the antenna radiator from a distance of less than 1 m when the radar is in operation.

Radio Frequency Radiation Hazard

The radar antenna emits electromagnetic radio frequency (RF) energy which can be harmful, particularly to your eyes. Never look directly into the antenna aperture from a close distance while the radar is in operation or expose yourself to the transmitting antenna at a close distance.

Distances at which RF radiation levels of 100 and 10 W/m^2 exist are given in the table below.

Note: If the antenna unit is installed at a close distance in front of the wheel house, your administration may require halt of transmission within a certain sector of antenna revolution. This is possible—Ask your FURUNO representative or dealer to provide this feature.

MODEL	Radiator type	Distance to 100 W/m^2 point	Distance to 10 W/m^2 point
1761 MK-3	XN10A	0.2 m	Worst case 3.0 m

⚠ DANGER

Before turning on the radar make sure no one is near the scanner unit.

Prevent the potential risk of someone begin struck by the rotating antenna and exposure to RF radiation hazard.

⚠ WARNING

Use the proper fuse.

Fuse rating is shown in the chapter 5.
Use of a wrong fuse can result in equipment damage

Do not operate the equipment with wet hands.

Electrical shock can result.

⚠ WARNING

Do not open the equipment.

Improper handling can result in electrical shock. Only qualified personnel shold work inside the equipment.

Do not disassemble or modify the equipment.

Fire electrical shock or serious injury can result.

Turn off the power immediately if water leaks into the equipment or the equipment is emitting smoke or fire.

Continued use of the equipment can cause fire or electrical shock.

Do not place liquid-filled containers on the top of the equipment.

Fire or electrical shock can result if a liquid spills into the equipment.

⚠ CAUTION

Do not use the equipment for other than its intended purpose.

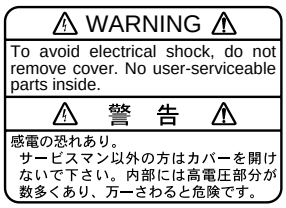
Use of the equipment as a stepping stool, for example, can result in personal injury or equipment damage.

No one navigation device should ever be solely replied upon for the navigation of a vessel.

Always confirm position against all available aids to navigation, for safety of vessel and crew.

Two warning labels are attached to the display unit and scanner unit. Do not remove these labels. If labels are peeling off or are illegible, contact a FURUNO agent or dealer.

<Display Unit>
Name: Warning Label (1)
Type: 86-003-1011-0
Code no.: 100-236-230



<Scanner Unit>
Name: Radiation Warning Label
Type: 03-142-3201-0
Code no.: 100-266-890

FOREWORD

Congratulations on your choice of the FURUNO MODEL 1761 MARK-3 Marine Radar. We are confident you will see why the FURUNO name has become synonymous with quality and reliability.

For over 50 years FURUNO Electric Company has enjoyed an enviable reputation for innovative and dependable marine electronics equipment. This dedication to excellence is furthered by our extensive global network of agents and dealers.

Your radar is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless properly installed and maintained. Please carefully read and follow the recommended procedures for installation, operation and maintenance.

While this unit can be installed by the purchaser, any purchaser who has doubts about his or her technical abilities may wish to have the unit installed by a FURUNO representative or other qualified technician. The importance of a through installation can not be overemphasized.

We would appreciate hearing from you, the end-user, about whether we are achieving our purposes.

Thank you for considering and purchasing FURUNO equipment.

Features

Your radar has a large variety of functions, all contained in a remarkably small cabinet.

The main features of the MODEL 1761 MARK-3 are:

- Traditional FURUNO reliability and quality in a compact, lightweight and low-cost radar.
- Durable brushless antenna motor.
- On-screen alphanumeric readout of all operational information.
- Standard features include EBL (Electronic Bearing Line), VRM (Variable Range Marker), Guard Alarm, Display Off Center, and Echo Trail.
- Watchman feature periodically transmits the radar to check for radar targets which may be entering the alarm zone.
- Ship's position in latitude and longitude, range and bearing to a waypoint, and ship's speed/heading/course can be shown in the bottom text area. (Requires a navigation aid which can output such data in IEC 61162 format.)
- Zoom feature provided.

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MENU TREE

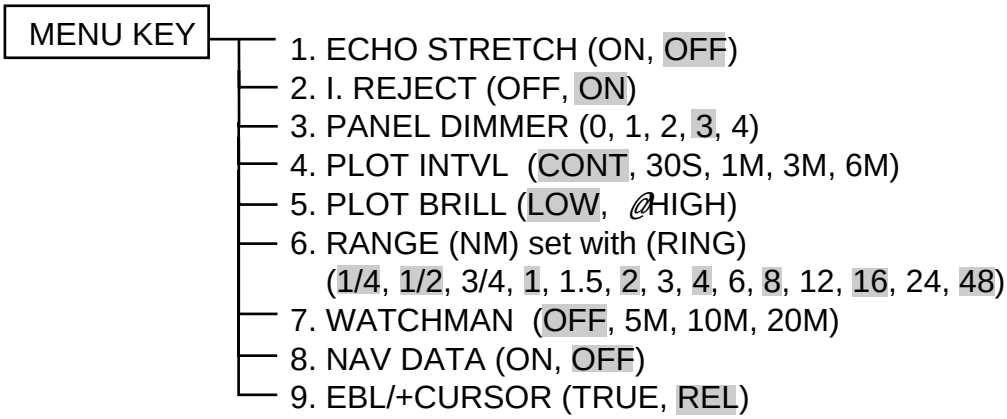
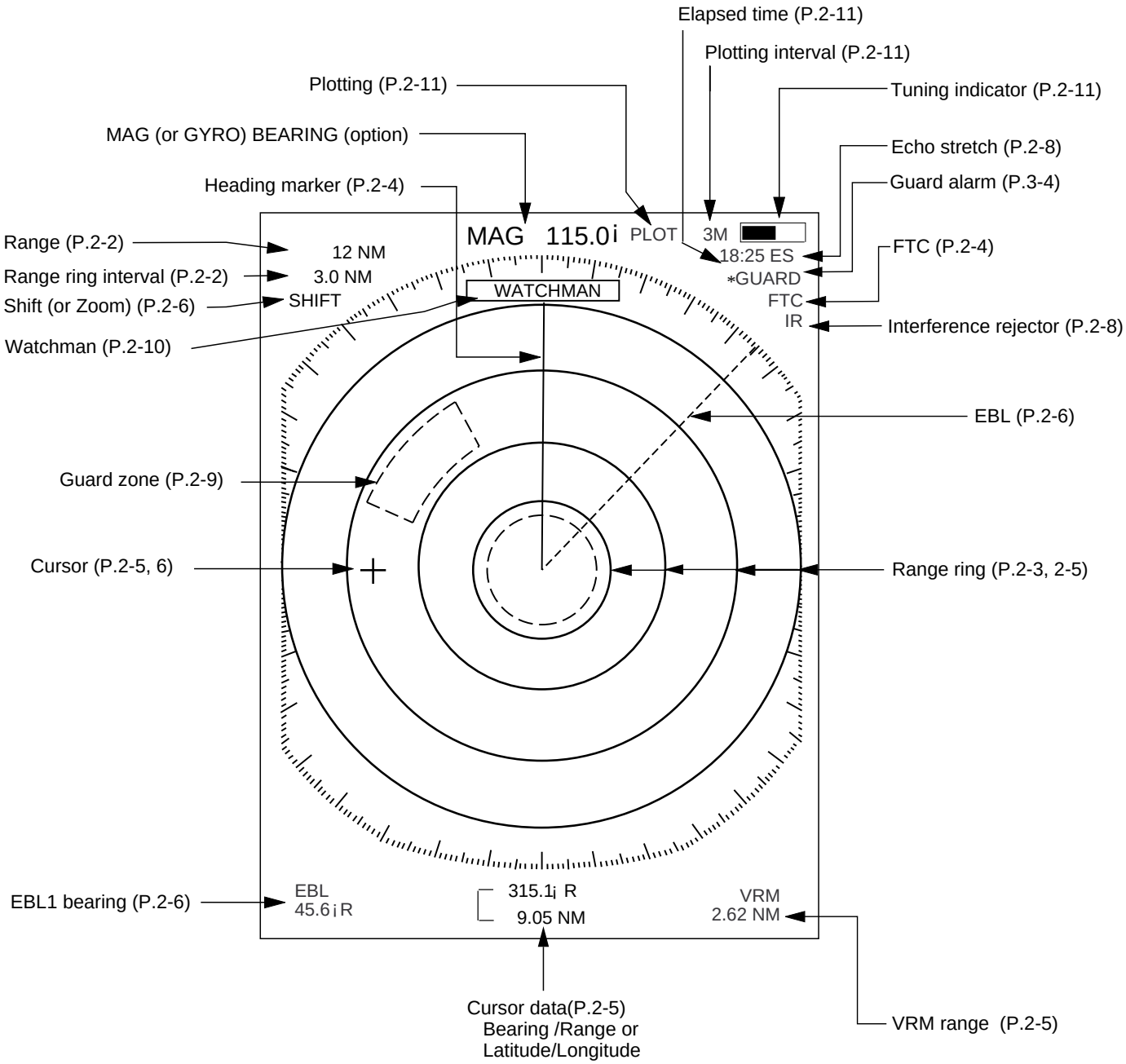
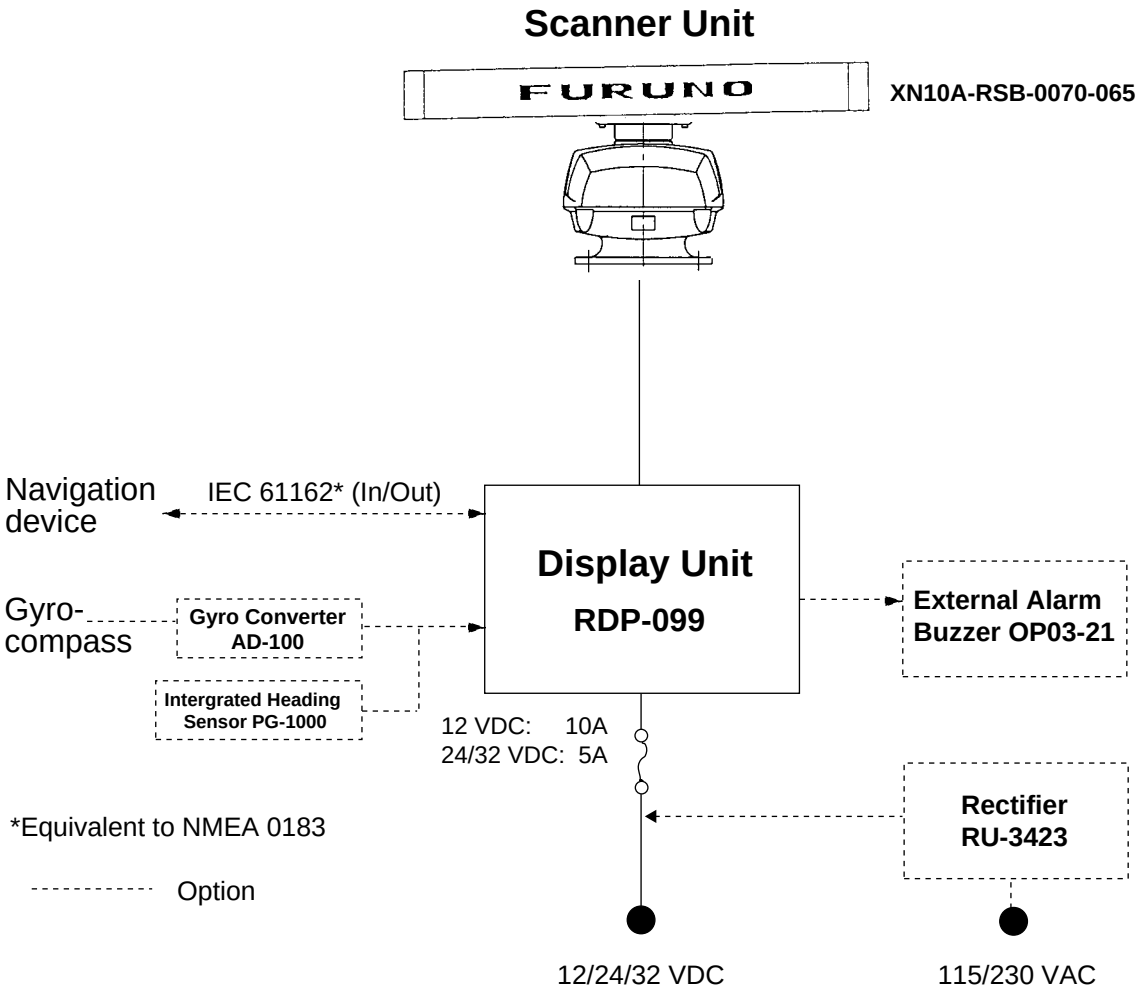

MENU KEY
1. ECHO STRETCH (ON, OFF)
2. I. REJECT (OFF, ON)
3. PANEL DIMMER (0, 1, 2, 3, 4)
4. PLOT INTVL (CONT, 30S, 1M, 3M, 6M)
5. PLOT BRILL (LOW, @HIGH)
6. RANGE (NM) set with (RING)
(1/4, 1/2, 3/4, 1, 1.5, 2, 3, 4, 6, 8, 12, 16, 24, 48)
7. WATCHMAN (OFF, 5M, 10M, 20M)
8. NAV DATA (ON, OFF)
9. EBL/+CURSOR (TRUE, REL)

TABLE OF CONTENTS BY INDICATION, MARKER



SYSTEM CONFIGURATION



1. PRINCIPLE OF OPERATION

1.1 What is Radar?

The term “RADAR” is an acronym meaning RAdio Detection And Ranging. Although the basic principles of radar were developed during World War II, echoes as an aid to navigation is not a new development.

1.2 How Ships Determined Position Before Radar

Before the invention of radar, when running in fog near a rugged shoreline, ships would sound a short blast on their whistles, fire a shot, or strike a bell. The time between the origination of the sound and the returning of the echo indicated how far the ship was from the cliffs or the shore. The direction from which the echo was heard indicated the relative bearing of the shore.

1.3 How Radar Determines Range

Radar determines the distance to the target by calculating the time difference between the transmission of a radar signal and the reception of the reflected echo. It is a known fact that radar waves travel at a nearly constant speed of 162,000 nautical miles per second. Therefore the time required for a transmitted signal to travel to the target and return as an echo to the source is a measure of the distance to the target. Note that the echo makes a complete round trip, but only half the time of travel is needed to determine the one-way distance to the target. This radar automatically takes this into account in making the range calculation.

1.4 How Radar Determines Bearing

The bearing to a target found by the radar is determined by the direction in which the radar scanner antenna is pointing when it emits an electronic pulse and then receives a returning echo. Each time the scanner rotates pulses are transmitted in the full 360 degree circle, each pulse at a slightly different bearing from the previous one. Therefore, if one knows the direction in which the signal is sent out, one knows the direction from which the echo must return.

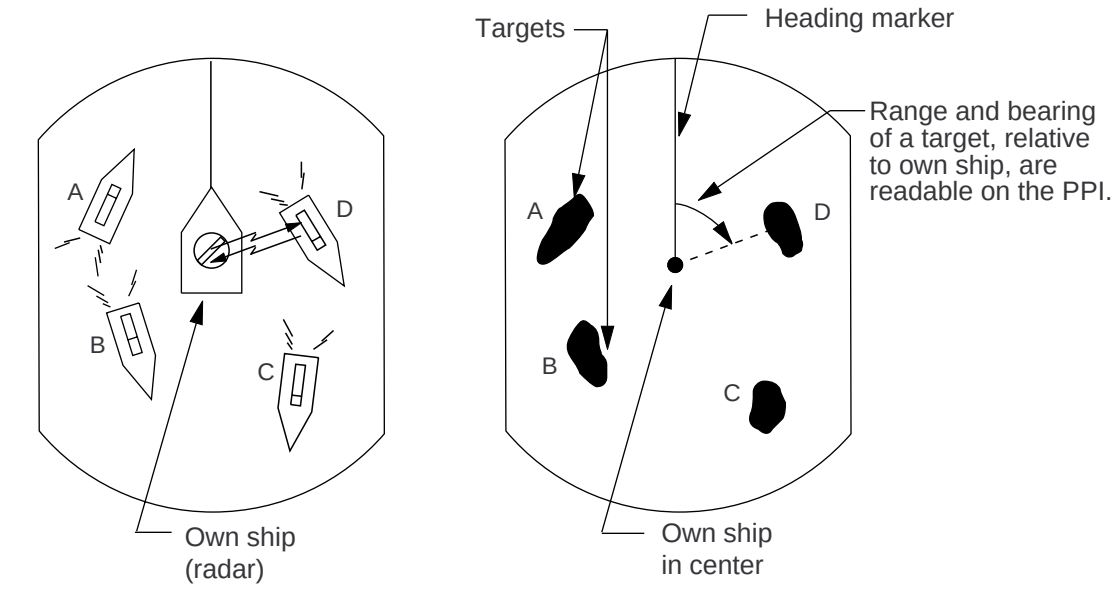
1.5 Radar Wave Speed and Scanner Rotation Speed

Note that the speed of the radar waves out to the target and back again as echoes is extremely fast compared to the speed of rotation of the scanner. By the time radar echoes have returned to the scanner, the amount of scanner rotation after initial transmission of the radar pulse is extremely small.

1.6 The Radar Display

The range and bearing of a target is displayed on what is called a Plan Position Indicator (PPI). This display is essentially a polar diagram, with the transmitting ship’s position at the center. Images of target echoes are received and displayed at their relative bearings, and at their distance from the PPI center.

With a continuous display of the images of targets, the motion of the transmitting ship is also displayed.



(A) Bird's eye view of situation **(B) Radar picture of (A)**

Figure 1-1 How radar works

2.1 Control Description

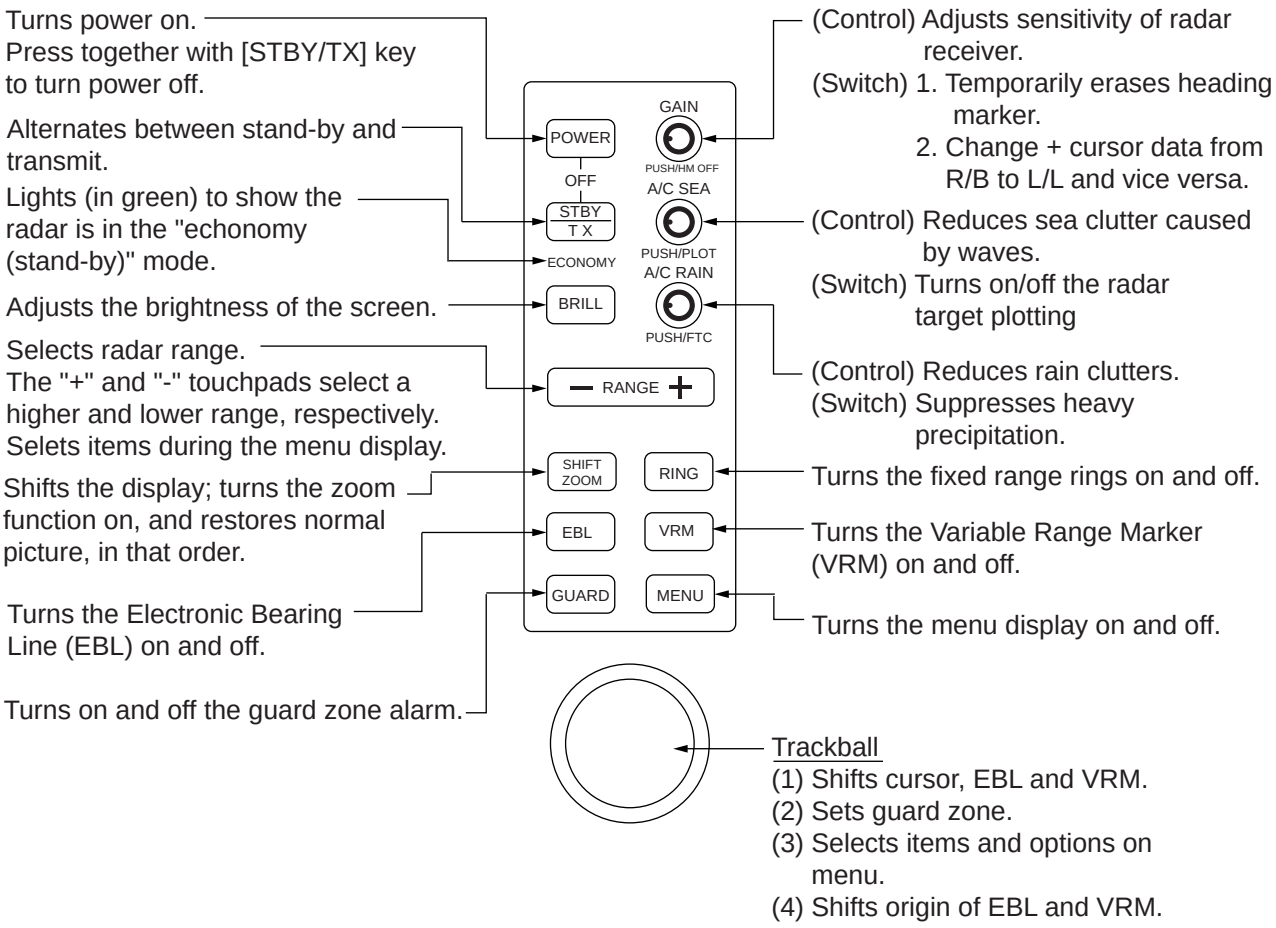


Figure 2-1 Control panel

2.2 Turning the Radar On/Off

After confirming there are no crew near the scanner unit, press the [POWER] key to turn on the power.

The front panel will light up. The magnetron takes about two minutes and thirty seconds to warm up before the radar can be operated. The time remaining for warm up of the magnetron appears at the center of the display, counting down from 2:29 to 0:01.

To turn off the radar, press the [POWER] and [TX] key together.

2.3 Transmitting

After the power is turned on and the magnetron has warmed up, the message “ST-BY” (Stand-By) appears at the center of the display, showing the radar is ready to transmit. However, no targets will appear on the screen until the radar is transmitting by pressing the [TX] key (TX is short for “transmit). In stand-by the radar is available for use at anytime - but no radar waves are being transmit.

2.4 Stand-by

When you won’t be using the radar for an extended period, but you want to keep it in a state of readiness, place it in stand-by by pressing the [TX] key. The display shows “STBY,” (default setting) or goes into the economy mode. (You can select stand-by condition on the menu.)

Economy mode

The CRT can be set to automatically turn itself off when in stand-by, to reduce power consumption. This feature is called the “economy mode”. When the economy mode is on, the “ECONOMY” indication under the [TX] key lights.

2.5 Selecting the Range

The range selected automatically determines the fixed range ring interval, the number of fixed range rings, pulselength, and pulse repetition rate, for optimal detection in short to long ranges. The range and ring interval appear at the top left corner of the display.

Selecting the range

Press the [- RANGE +] key. The range and range ring interval appear at the top left corner on the display.

Tips for selecting the range

- When navigating in or around crowded harbors, select a short range to watch for possible collision situation.
- If you select a lower range while on open water, increase the range occasionally to watch for vessels that may be heading your way.

2.6 Adjusting Picture Brilliance

The [BRILL] key adjusts the brilliance of the radar picture in eight levels.

Press the [BRILL] key to set the brilliance level.

2.7 Adjusting Receiver Sensitivity

The [GAIN] control adjusts the sensitivity of the receiver. It works in precisely the same manner as the volume control of a broadcast receiver, amplifying the signals received.

The proper setting is such that the background noise is just visible on the screen. If you set up noise is just visible on the screen. If you set up for too little sensitivity, weak echoes may be missed. On the other hand excessive sensitivity yields too much background noise; strong targets may be missed because of the poor contrast between desired

echoes and the background noise on the display.

To adjust receiver sensitivity, transmit on long range, and adjust the [GAIN] control so background noise is just visible on the screen.

Tips on adjusting GAIN

- In certain circumstances it may be useful to reduce the gain slightly to improve range resolution, clear up the picture, or reduce clutter caused by rain or snow.
- Range resolution is a measure of the capability of a radar to display as separate pips the echoes received from two targets which are on the same bearing, and are close together radially. With reduction in the gain setting, the echoes may be made to appear as separate pips on the display.
- When sailing or cruising in crowded regions a slight reduction in gain often helps to clear up the picture. This should be done carefully, otherwise weak targets may be missed.
- Echoes from ships inside a squall or storm may be obscured if the gain is at its normal setting, since the clutter may have masked, but not completely, echoes from the targets.

Note: In all cases, return the gain to its original position after any temporary reduction is no longer required.

2.8 Adjusting the A/C SEA Control (reducing sea clutter)

Echoes from waves can be troublesome, covering the central part of the display with random signals known as “sea clutter”. The higher the waves, and the higher the antenna above the water, the further the clutter will extend. Sea clutter appears on the display as many small echoes which might affect radar performance. (See the left-hand figure in Figure 2-2.) When sea clutter masks the picture, adjust the A/C SEA control to reduce the clutter.

How the A/C SEA control works

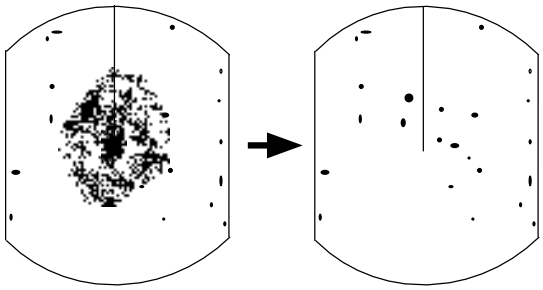
The [A/C SEA] control reduces the amplification of echoes at short ranges (where clutter is the greatest) and progressively increases amplification as the range increases, so amplification will be normal at those ranges where there is no sea clutter.

Adjusting the A/C SEA control

The proper setting of the A/C SEA should be such that the clutter is broken up into small dots, and small targets become distinguishable.

If the control is set too low, targets will be hidden in the clutter, while if it is set too high, both sea clutter and targets will disappear from the display. In most cases adjust the control until clutter has disappeared to leeward, but a little is still visible windward.

1. Confirm that the sensitivity is properly adjusted, and then transmit on short range.
2. Adjust the [A/C SEA] control so small targets are distinguishable but some clutter remains on the display.



Sea clutter at display center

A/C SEA control adjusted; sea clutter suppressed.

Figure 2-2 How to adjust the A/C SEA control

Tip for adjusting the A/C SEA

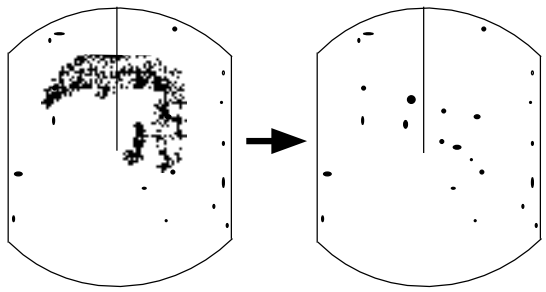
A common mistake is to over-adjust the circuit so all the removed. As an example set up for maximum A/C SEA. You will see how the center of the display becomes dark. This dark zone can be dangerous (targets may be missed), especially if the sensitivity is not properly adjusted. Always leave a little clutter visible on the display to be sure weak echoes will not be suppressed. If there is no clutter visible on the display, turn off the circuit.

2.9 Adjusting the A/C RAIN Control (reducing rain clutter)

The vertical beamwidth of the antenna is designed to see surface targets even when the ship is rolling. However, by this design the unit will also detect rain clutter (rain, snow, hail, etc.) in the same manner as normal targets. Figure 2-3 shows the appearance of rain clutter on the display.

Adjusting A/C RAIN

When rain clutter masks echoes, adjust the [A/C RAIN] control. This control splits up these unwanted echoes into a speckled pattern, marking recognition of solid targets easier.



Appearance of rain clutter

A/C RAIN control adjusted; rain clutter suppressed.

Figure 2-3 Effect of A/C RAIN

Note: In addition to reducing clutter, the [A/C RAIN] control can be used in fine weather to clarify the picture when navigating in confined waters. However, with the circuit activated the receiver is less sensitive. Therefore, turn off the circuit when its function is not required.

2.10 Adjusting FTC

To suppress rain clutter from heavy storms or scattered rain clutter, press the [A/C RAIN] control ([FTC] switch). The FTC circuit splits up these unwanted echoes into a speckled pattern, marking recognition of solid targets easier. “FTC” appears at the top right-hand corner of the display when the circuit is turned on.

Note: In addition to reducing clutter, the FTC can be used in fine weather to clarify the picture when navigating in confined waters. However, with the circuit activated the receiver is less sensitive. Therefore, turn off the circuit when its function is not required.

2.11 Tuning the Radar Receiver

The radar receiver is tuned automatically each time you turn on the power, thus there is no front panel control for adjustment of the receiver. To show the automatic tuning circuit is working, a tuning bar displays tuning condition.

2.12 Erasing the Heading Marker

The heading marker may occasionally mask a target. To view the target, you can temporarily erase the heading marker by pressing and holding down the [GAIN (HM OFF)] control. Release the control to re-display the markers.

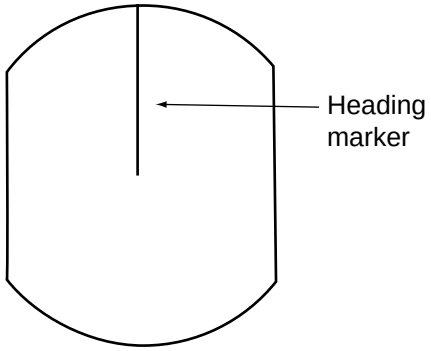


Figure 2-4 Heading marker

2.13 Select the Cursor Data Display

When connecting with NAV (IEC61162 format) and gyro converter (IEC61162 or AD-10 format), this radar can show the cursor position by Latitude/longitude at bottom of screen.

Each time pressing [HM OFF] key, the data will change from Range/Bearing to Latitude/longitude and vice versa.

When the cursor position is displayed by Latitude/Longitude, pressing the [HM OFF] key outputs L/L data of the cursor position (TLL) to the plotter. Then Range/Bearing are displayed instead of L/L.

2.14 Turning the Range Ring On/Off

When range rings obscures a target, you can erase them by pressing the [RING] key.

2.15 Measuring the Range

You can measure the range to a target three ways: by the range rings, by the cursor, and by the VRM (Variable Range Marker).

Measuring range by range rings

Count the number of rings between the center of the display and the target. Check the range ring interval and judge the distance of the echo from the inner edge of the nearest ring.

To turn the rings on or off, press the [RING] key.

Measuring range by cursor

Operator the trackball to place the cursor intersection on the inside edge of the target echo. The range to the target, as well as the bearing, appears at the bottom of the display.

Measuring by VRM

1. Press the [VRM] key to display a VRM. (The VRM is the dotted ring.)
2. Place the VRM on the inside edge of the target by operating the trackball.
3. Press the [VRM] key again to fix the VRM to the position.
4. Check the range readout to find the range to the target. To erase the VRM, press and hold down the [VRM] key for about three seconds.

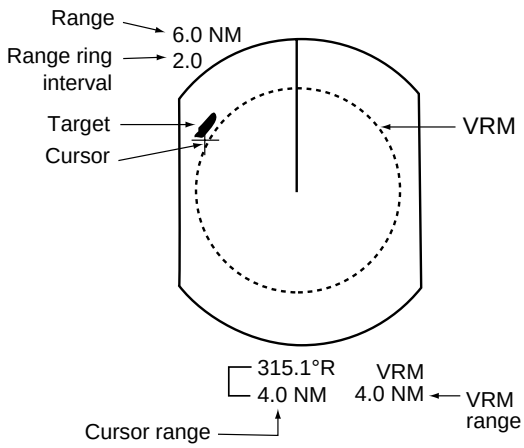


Figure 2-5 Measuring Range by the Cursor and the VRM

Unit of range measurement

You can display the range readouts of the VRM and the cursor in nautical miles or kilometers. This is done at installation.

2.16 Measuring the Bearing

There are two ways to measure the bearing to a target: by the cursor, and by the EBL (Electronic Bearing Range).

Measuring bearing by cursor

Operate the trackball to bisect the target with the cursor intersection. The bearing to the target appears at the bottom of the display.

Measuring by EBL

1. Press the [EBL] key to display an EBL. (The EBL is the dotted line.)

2. Position the EBL so it bisects the target by operating the trackball.
3. Press the [EBL] key again to fix the EBL to the position.
4. Check the bearing readout to find the bearing of the target. To erase the EBL, press and hold down the [EBL] key for about three seconds.

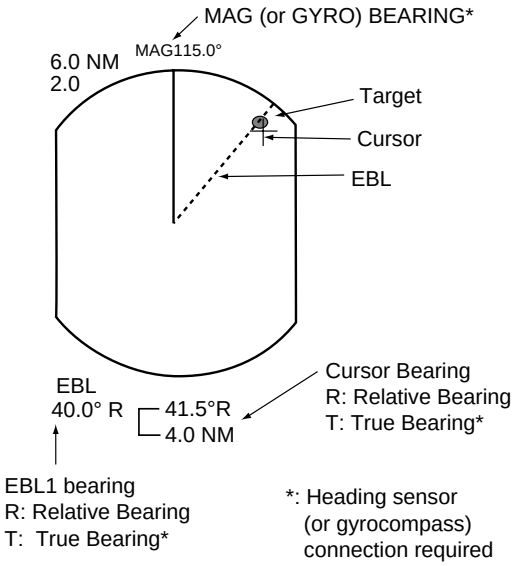


Figure 2-6 Measuring Bearing by the EBL and Cursor

The bearing measured by the cursor or the EBL can be displayed in relative or true bearings (heading sensor or gyrocompass connection required). Relative bearings are relative to the bow of the vessel, and true bearings are relative to the True North. The indication “MAG” (or GYRO”) and the heading sensor (or gyrocompass) bearing (your ship’s bearing) appear at the top of the screen.

Note that the bearing to the cursor always varies with trackball operation. The EBL and its indication, however, are automatically fixed when the [EBL] key is pressed or 10 seconds elapses without trackball operation.

Tips on measuring bearing

- Bearing measurements of smaller targets pips are more accurate; the center of larger target pips is not as easily identified.
- Bearings of stationary or slower moving targets are more accurate than bearings of faster moving targets.
- To minimize bearing errors keep echoes in the outer half of the picture by changing the range scale; angular difference becomes difficult to resolve as a target approaches the center of the display.

2.17 Shifting and Zooming the Display

The [SHIFT/ZOOM] key has two functions: display shifting and display zoom. Each time the key is pressed the function changes in the following sequence.

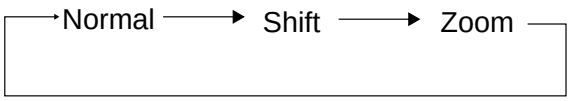


Figure 2-7 SHIFT/ZOOM key sequence

Shift

The own ship’s position can be shifted to any position within the current range. The primary advantage of the shifted display is that for any range setting, the view ahead of your own ship can be extended without changing the range.

Place the cursor on area you wish to shift to the screen center and then press the [SHIFT/ZOOM] key. The indication “SHIFT” appears. To restore normal operation press the key twice.

Note: If the cursor is not within the current range when the key is pressed, an audible beep sounds and the outermost range ring blinks twice , even if the range rings are off.

Zoom

The zoom feature allows you to double the area between own ship and an arbitrary location, to take a closer look at an area of interest without changing the range.

1. Operate the trackball to place the cursor on the target you want or area you want to zoom.

2. Press the [SHIFT/ZOOM] key. The indication “ZOOM” appears and brinks.
3. To turn off the zoom, press the [SHIFT/ZOOM] key again, or change the range.

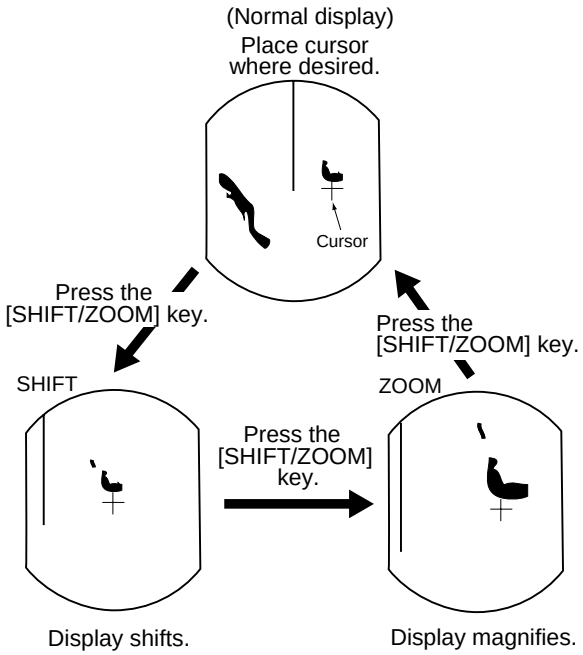


Figure 2-8 Shifting and zooming the display

2.18 Menu Operation

The menu, consisting of 9 items, mostly contains less-often used functions which once preset do not require regular adjustment. To open or close the menu, press the [MENU] key. You can select menus by using the trackball, then select item with the [RANGE] key.

Note: Current selections shown in reverse video.

MENU	SEL MENU BY TRKBALL: ITEMS WITH RANGE KEY
1 ECHO STRETCH	ON **OFF**
2 I. REJECT	**ON** OFF
3 PANEL DIMMER	0 1 2 **3** 4
4 PLOT INTVL	**CONT** 30S 1M 3M 6M
5 PLOT BRILL	**LOW** HIGH
6 RANGE (NM) SET WITH (RING)	**1/4** **1/2** 3/4 **1** 1.5 **2** 3 **4** 6 **8** 12 **16** 24 36 **48**
7 WATCHMAN	**OFF** 5M 10M 20M
8 NAV DATA	ON **OFF**
9 EBL/+CURSOR	TRUE **REL**

Figure 2-9 MENU Display

Table 2-1 Menu Description

No.	Menu	Function	Factory setting
1	ECHO STRETCH	Activates and releases the echo stretch function, which stretches echoes lengthwise for better distance.	OFF
2	INTERFERENCE REJECTION	Reduces or eliminates radar interference.	ON
3	PANEL DIMMER	Adjusts the backlighting of the front panel in five steps.	3
4	PLOT INTERVAL	Changes the plotting interval in five steps; 30sec., 1min., 3min., 6min. and continuous.	CONT
5	PLOT BRILLIANCE	Adjusts the brightness of the plotted echoes.	LOW
6	RANGE	Presets the ranges you want to use. The preset ranges are in reverse video. 1. With the [RANGE] key, place the underline under the range you want to select or deselect. Press the [RING] key to select or deselect. Maximum number of ranges is all ranges. 2. Minimum number of range is two.	1/4 1/2 1 2 4 8 16 48
7	WATCHMAN	Turns on and selects the watchman interval. 1. Select interval (5min., 10min. or 20min.) with the [RANGE] key. 2. Press the [MENU] key to activate the watchman mode. The "ECONOMY" indication lights after the radar transmits for about 30 seconds.	OFF
8	NAV DATA	Turns the navigation data display (navigation input required) on and off.	OFF
9	EBL/+CURSOR BEARING	Selects the bearing measured by the EBL or cursor in true (magnetic compass or gyrocompass connection required) or relative bearing. "TRUE": relative to the True North "REL": relative to the bow of the vessel	REL

2.19 Echo Stretch

Normally, the reflected echoes from long distance targets appear on the screen as weaker and smaller blips even through they are compensated by the radar's internal circuitry. The Echo Stretch function magnifies these small blips.

1. Press the [MENU] key to open the menu.
2. Operate the trackball to select "1. ECHO STRETCH".
3. Press the [RANGE] key to select "ON".

The indication "ES" appears at the upper right-hand side of the screen and the echoes are doubled lengthwise.

To turn off the echo stretch, select "OFF" on the MENU display.

Note 1: This function magnifies not only targets but also sea clutter and radar interference are properly adjusted before activating the echo stretch.

Note 2: This function is inactivate on short ranges, that is 0.25 to 1 nautical miles. "ES" appears in reverse video when the echo stretch is turned on in those ranges.

2.20 Suppressing Radar Interference

Radar interference may occur when near another shipborne radar operating in the same frequency band as your radar. Its on-screen appearance is many bright dots either scattered at random or in the form of dotted lines extending from the center (or the edge) to the edge (or the center) of the display. Figure 2-11 illustrates interference in the form of curved spokes, Interference effects are distinguishable from normal echoes because they do not appear in the same place on successive rotations of the scanner.

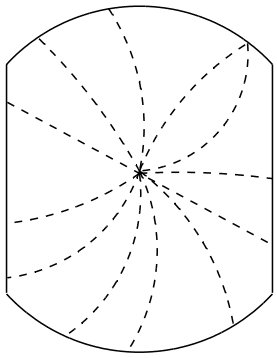


Figure 2-10 Radar interference

1. Press the [MENU] key to open the menu.
2. Operate the trackball to select "2. I. REJECT".
3. Press the [RANGE] key to select "ON". (Factory setting is ON.)

The indication "IR" appears at the upper right-hand side of the screen. Press the [MENU] key again to erase the menu display.

2.21 Adjusting Control Panel Brilliance

Adjusts the backlighting of the front panel in five steps.

1. Press the [MENU] key to open the menu.
2. Operate the trackball to select "3. PANEL DIMMER".
3. Press the [RANGE] key to select level desired.
4. Press the [MENU] key again to erase the menu.

2.22 Selecting Ranges

This radar has 14 ranges, some which you may not require. You can select or deselect ranges as follows.

1. Press the [MENU] key to open the menu.
2. Operate the trackball to select “6. RANGE”.
3. Press the [RANGE] key to place the underline under the range you want to select or deselect.
4. Press the [RING] key to select or deselect.
5. Repeat step 4 and 5.

   Maximum number of ranges is all ranges.

   Minimum number of ranges is two.

2.23 EBL/Cursor Bearing Reference

EBL and cursor bearing can be displayed relative to own ship’s heading (Relative) or with reference to North (True).

Note: Magnetic compass or gyrocompass connection required for true bearing.

1. Press the [MENU] key to open the menu.
2. Operate the trackball to select “9. EBL/+CURSOR”
3. Press the [RANGE] key to select “TRUE” or “REL (Relative)”.

2.24 Guard Alarm

The alarm allows the operator to set the desired range (0 to maximum range) and bearing (0 to 360 degrees) for a guard zone, called Auto In/Out alarm. When ships, islands, landmasses, etc. go into (or go out of) the guard zone an audible alarm sounds to call the operator’s attention.

Before setting the alarm, be sure the [GAIN] control is properly adjusted, because the audible alarm sounds when the fifth or more level quantization echoes go into or go out of the guard zone.

1. Mentally create the guard zone you want to display on-screen. See Figure 2-12.
2. Set upper (lower) left edge of the guard zone with the cursor, and press the [GUARD] key.

   The indication “*GUARD” (asterisk blinking) appears at the upper right-hand side of the screen. See Figure 2-12 (2). The asterisk indicates the guard zone is partially set, but the alarm function has not been actuated. It disappears once the guard zone is set completely.
3. Moving the trackball clockwise, set the lower (upper) right edge of the guard zone. The guard zone now appears on the display and alarm function has been actuated, See Figure 2-12 (3).

Note: To create a 360 degree guard zone, rotate the cursor counterclockwise instead of clockwise.

4. Press the [GUARD] key again. The asterisk disappears and the alarm function is actuated after three to five antenna scannings, and then, the indication “GUARD” is replaced by “G(IN)” or “G(OUT)”.
5. Any ships, landmasses, etc. coming into or going out of the guard zone will trigger the audible alarm. If the audible alarm sounds you can silence it by pressing the [GUARD] key. When this is done the indication “GUARD” appears in reverse video.
6. Press the [GUARD] key again to restore the audible alarm. “GUARD” lights in normal video.
7. To cancel both the guard zone and the audible alarm, press and hold down the [GUARD] key for three seconds.

Note 1: When the range is less than the half of the guard zone range, the guard zone disappears from the screen and “UP RANGE” indication appears. If this happens, select a range which will again display the guard zone on the screen.

Note 2: A target echo does not always mean a landmass, reef, ships or surface objects but can imply returns from sea surface or precipitation. As the level of these returns varies with environment, the operator should (properly) adjust the A/C SEA, A/C RAIN, FTC and GAIN to be sure target echoes within the guard zone are not overlooked by the alarm system.

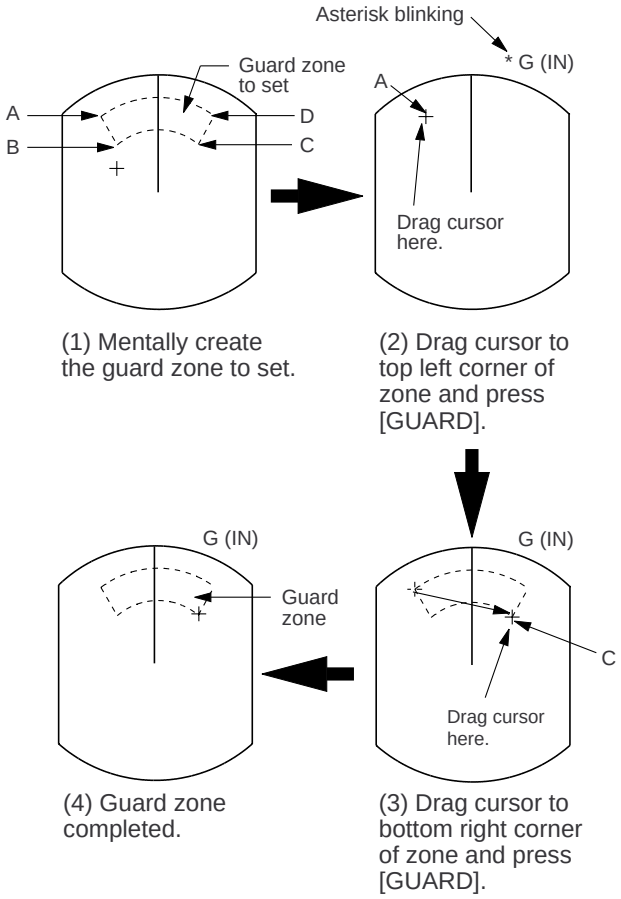


Figure 2-11 Setting Guard Zone

Auto In/Out Alarm

When the guard zone is set completely, the radar starts searching for targets inside the guard zone for 8 to 12 seconds. The indication “GUARD” appears during this period.

Case 1: When there are targets inside the zone, the alarm zone is automatically set to “Auto Out Alarm” mode and the indication “GUARD” is replaced by “G (OUT)”. The audible alarm sounds only on targets which go out of the zone or disappear. See Figure 2-13 (1).

Note: The audible alarm does not sound for the target originally existing the zone.

Case 2: When no targets exist inside the zone, the alarm zone is automatically set to “Auto In Alarm” mode and the indication “GUARD” is replaced by “G (IN)”. The audible alarm sounds only on targets which go into the zone. See Figure 2-13 (2).

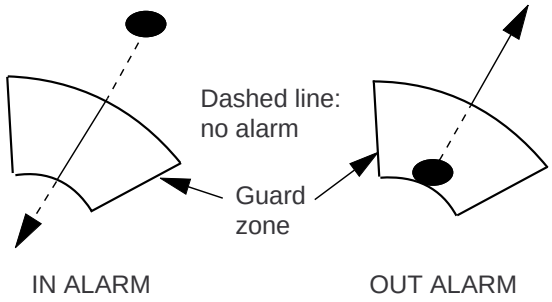


Figure 2-12 Auto In/Out Alarm

2.25 Watchman

The watchman function turns on the radar and transmits its for about 30 seconds at a predetermined interval to check for targets in a guard zone. This feature is useful when you do not need the radar’s function continuously but want to be alerted to radar targets in an area.

When the watchman feature is on, an internal timer turns on the radar every 5, 10 or 20 minutes and the radar transmits for 30 seconds to check for the existence of radar targets in a guard zone.

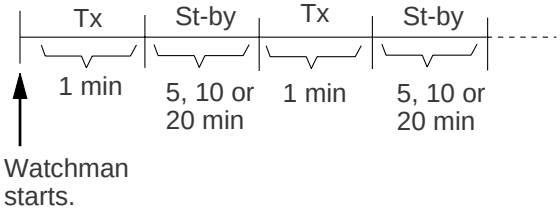


Figure 2-13How watchman works

1. Determine the guard zone (usually 360 degrees) with the guard alarm function.
2. Press the [MENU] key to open the menu.
3. Operate the trackball to select “7. WATCHMAN” .
4. Press the [RANGE] key to select a transmission interval.
5. Press the [MENU] key to actuate the watchman mode. The indication “WATCHMAN” appears and the radar transmits for one minute and then turns to stand-by, and “ECHONOMY” lights.

Note: The antenna radiator does not rotate in the “ECHONOMY” (stand-by) mode. However, the radiator rotates continuously during the watchman mode.

6. The radar automatically starts transmitting after the time selected at step 4 has passed. It transmits for one minute approximately and examines the guard zone for change.
   (a) If the condition is unchanged, the radar automatically returns to stand-by again and continues operating in the watchman mode.
   (b) If the condition differs from the previous one, the radar sounds an audible alarm, cancels the watchman mode and transmits continuously.
7. To cancel the watchman mode manually, press any key.

2.26 Plotting

This function plots the movement of other ships relative to your own ship.

Press the [PLOT (A/C RAIN)] control to start plotting. The indication “PLOT” and a timer appear at the top right-hand corner of the screen and movement of all targets is plotted. The timer counts up from 0:01 to 99:59, whereupon the timer indication freezes but plotting continues. Targets initially are updated every 15 seconds. However, you can select intervals of 30 seconds, 1 minute, 3 minutes or 6 minutes through the MENU display (Refer to Chapter 3). The plotting interval (except for 15 seconds) appears to the right of the indication PLOT.

If the range is changed during plotting, plotting begins anew with the newly selected range. To cancel plotting, press the [PLOT] key.

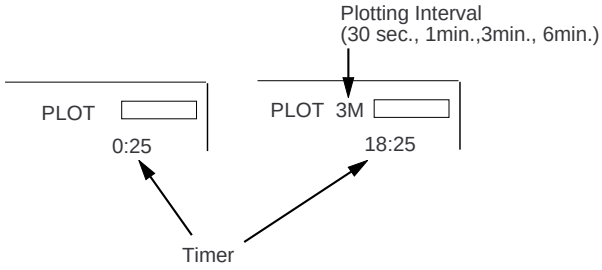


Figure 2-14 Plotting Indications

Plot Brilliance

The brilliance of plotted echoes is selectable through the MENU display. Press the [MENU] key and select “5. PLOT BRILLIANCE”.

2.27 Navigation Data Display

Navigation data can be displayed on the screen if your radar receives navigation input form a Loran-C, NNSS (satellite navigator) or GPS navigator whose output formats is IEC 61162 or FURUNO CIF. Data displayable include own ship’s position in latitude and longitude (or Loran-C time differences (TDs)), bearing and range to a waypoint selected on the nav aid, own ship’s speed, heading and course, In addition, if a heading sensor or gyrocompass is also connected, a line connects a waypoint (selected on navaid), denoted by a dashed ring, with the own ship’s position.

To return the navigation data display on or off, press the [MENU] key and select “8. NAV DATA”.

To display TDs instead of L/L, press the [GAIN] control. Press the control again to restore L/L.

If the output format is FURUNO CIF a jumper wire must be connected to “JUP1” on the SPU Board in the display unit. Note that for CIF format the bearing measurement method (Magnetic or True) does not appear for bearing to waypoint data.

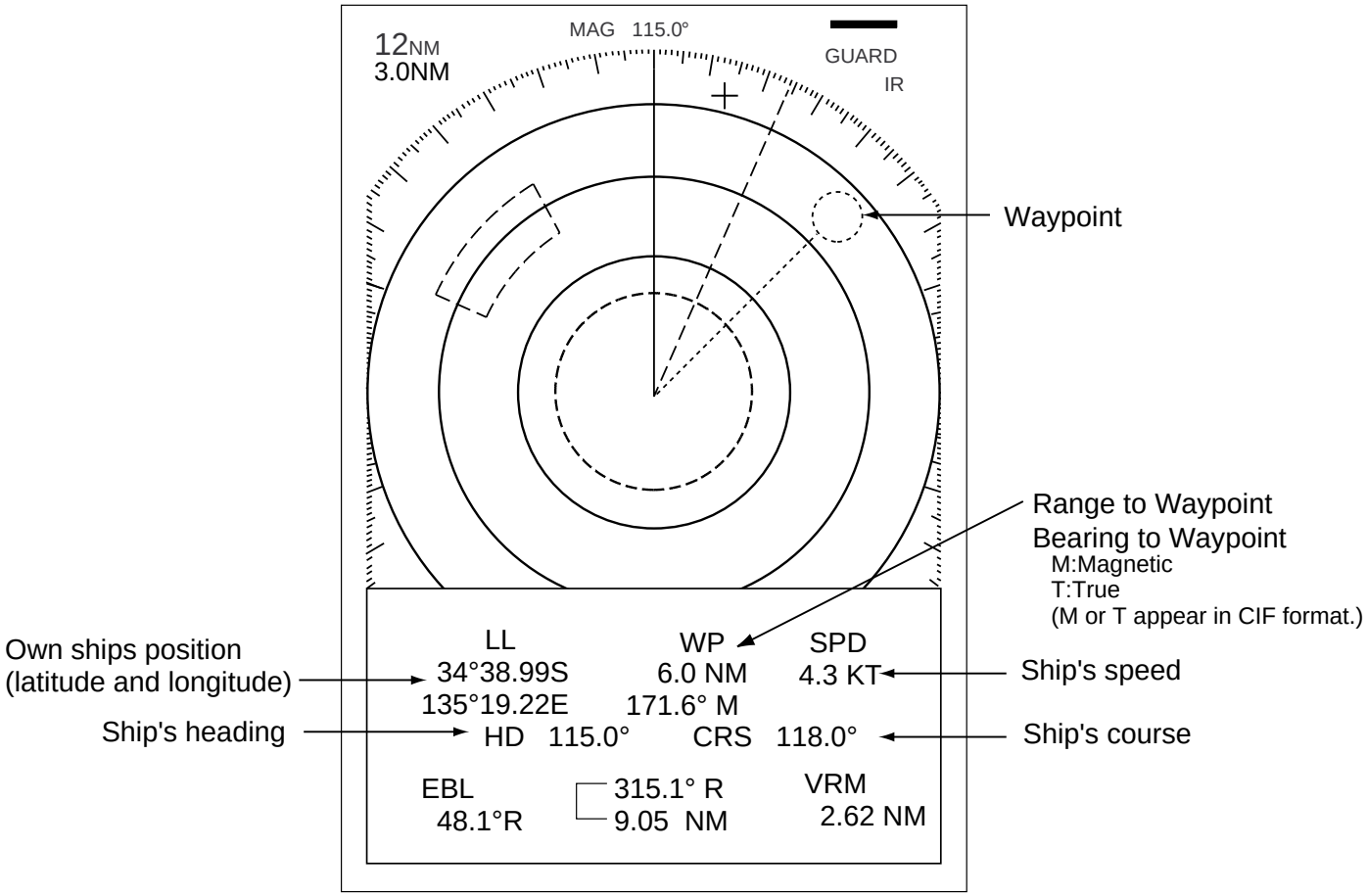


Figure 2-15 Navigation Data on the Screen

3. FALSE ECHOES

Occasionally false echoes appear on the screen at positions where there is no target. In some cases the effects can be reduced or eliminated. The operator should familiarize himself or herself with the appearance and effects of these false echoes, so as not to confuse them with echoes from legitimate contacts.

3.1 Multiple Echoes

Multiple echoes occur when a short range, strong echo is received from a ship, bridge, or breakwater. A second, a third or more echoes may be observed on the display at double, triple or other multiples of the actual range of the target as shown in Figure 4-1. Multiple reflection echoes can be reduced and often removed by decreasing the sensitivity or properly adjusting the A/C SEA.

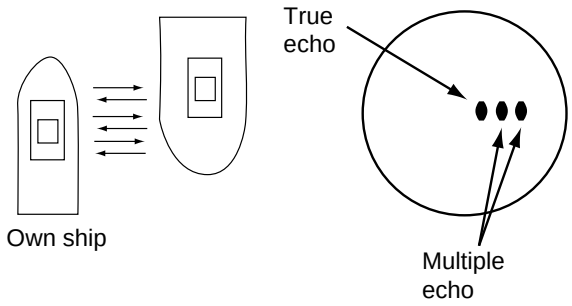


Figure 3-1 Multiple echoes

3.2 Side-lobe Echoes

Every time the scanner rotates, some radiation escapes on each side of the beam—called “side-lobes.” If a target exists where it can be detected by the side-lobes as well as the main-lobe, the side-lobe echoes may be represented on both sides of the true echo at the same range, as shown in Figure 4-2. Side-lobes show usually only at short ranges and from strong targets. They can be reduced through careful reduction of the sensitivity or proper adjustment of the A/C SEA.

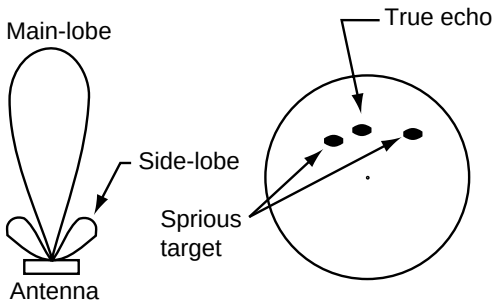


Figure 3-2 Side-lobe echoes

3.3 Indirect Echoes

Indirect echoes may be returned from either a passing ship or returned from a reflecting surface on your own ship, for example, a stack. In both cases, the echo will return from a legitimate contact to the scanner by the same indirect path. The echo will appear on the same bearing of the reflected surface, but at the same range as the direct echo. Figure 4-3 illustrates the effect of an indirect echo. Indirect echoes may be recognized as follows:

- they usually occur in a shadow sector
- they appear on the bearing of the obstruction but at the range of the legitimate contact
- when plotted, their movements are usually abnormal, and
- their shapes may indicate they are not direct echoes.

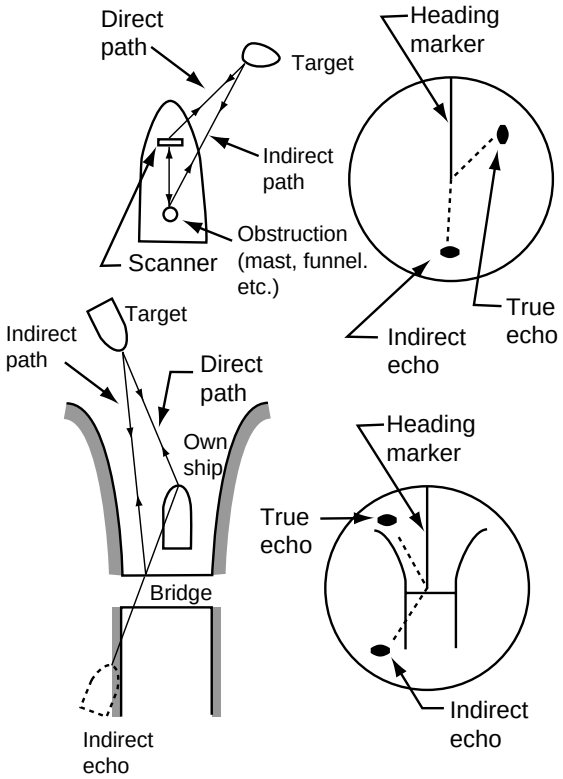


Figure 3-3 Indirect echoes

3.4 Blind and Shadow Sectors

Funnels, stacks, masts, or derricks in the path of antenna may reduce the intensity of the radar beam. If the angle subtended at the antenna is more than a few degrees a blind sector may be produced. Within the blind sector small targets at close range may not be detected while larger targets at much greater ranges may be detected. See Figure 4-4.

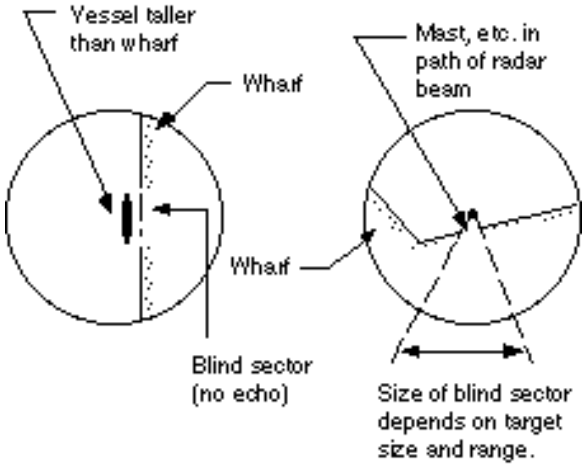


Figure 3-4 Blind and shadow sectors

3.5 SART (Search and Rescue Transponder)

A Search and Rescue Transponder (SART) may be triggered by any X-Band (3 cm) radar within a range of approximately 8 n.miles. Each radar pulse received causes it to transmit a response which is swept repetitively across the complete radar frequency band. When interrogated, it first sweeps rapidly (0.4 µs) through the band before beginning a relatively slow sweep (7.5 µs) through the band back to the starting frequency. This process is repeated for a total of twelve complete cycles. At some point in each sweep, the SART frequency will match that of the interrogating radar and be within the pass band of the radar receiver. If the SART is within range, the frequency match during each of the 12 slow sweeps will produce a response on the radar display, thus a line of 12 dots equally spaced by about 0.64 nautical miles will be shown.

When the range to the SART is reduced to about 1 nm, the radar display may show also the 12 responses generated during the fast sweeps. These additional dot responses, which also are equally spaced by 0.64 nm, will be interspersed with the original line of 12 dots. They will appear slightly weaker and smaller than the original dots.

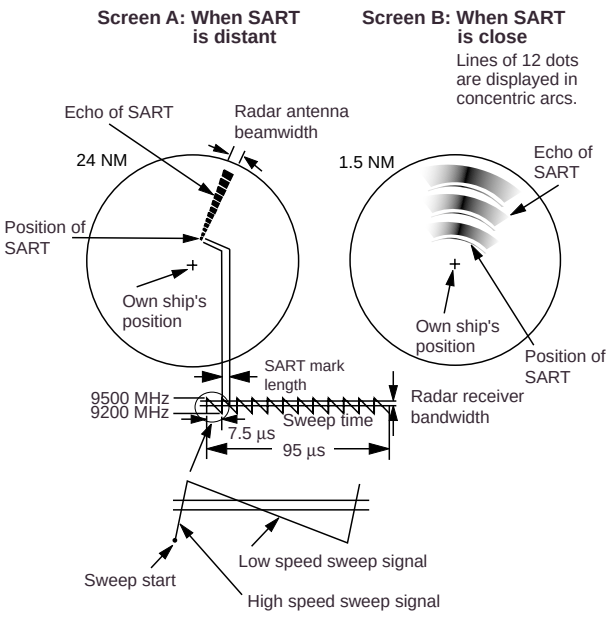


Figure 3-5 SART display

Showing SART marks on the radar display

To show the SART marks only on the radar display, detune the radar receiver manually. This erases or weakens all normal radar echoes, but, the SART marks are not erased because the SART response signal scans over all frequencies in the 9 GHz band. When the radar approaches the SART in operation, the SART marks will enlarge to large arcs, blurring a large part of the screen. Reduce the sensitivity and adjust the sea clutter control of the radar.

Summary to detect SART response

1. Use range scale of 6 or 12 nm as the spacing between the SART responses is about 0.6 nm (1125 m) to distinguish the SART.
2. Turn off the automatic clutter suppression.
3. Turn off the Interference Rejector.

General remarks on receiving SART

Radar range scale

When looking for a SART it is preferable to use either the 6 or 12 nautical mile range scale. This is because the total displayed length of the SART response of 12 (or 24) dots may extend approximately 9.5 nautical miles beyond the position of the SART and it is necessary to see a number of response dots to distinguish the SART from other responses.

SART range errors

When responses from only the 12 low frequency sweeps are visible (when the SART is at a range greater than about 1 nm), the position at which the first dot is displayed may be as mush as 0.64 nm beyond the true position of the SART. When the range closes so that the fast sweep responses are seen also, the first of these will be no more than 150 meters beyond the true position.

4. MAINTENANCE & TROUBLESHOOTING

This chapter tells you how to keep your radar in good working order. Before reviewing this chapter please read the safety information which follows.

⚠ DANGER

Turn off the power before performing any maintenance or troubleshooting procedure.

Hazardous voltages can shock, burn or cause death. Only qualified personnel totally famillier with electrical circuits should work inside the units.

RF RADIATION HAZARD

The radar scanner emits high frequency radio radiation which can be harmful, particularly to your eyes.

Never look directly into the scanner from a distance of less than two feet when the radar is in operation as you could injure the cornea of your eyes. Always make sure the radar is set to stand-by or is turned off before starting work on the scanner unit.

4.1 Preventive Maintenance

Regular maintenance is important for good performance. Always keep the equipment as free as possible from dirt, dust, and water splashes. Make sure all screws securing the components are properly tightened.

A maintenance program should be established and should at least include the items listed in Table 4-1.

4.2 Replacing the Fuse

The fuse on the rear panel of the display protects the equipment against reverse polarity of ship's mains, overcurrent, and equipment fault. If the fuse blows, find the cause before replacing it. Never use an incorrect fuse - serious damage to the equipment may result and void the warranty.

12V: 10A fuse
24/32V: 5A fuse

⚠ CAUTION

Use the proper fuse.

Use of a wrong fuse can result in equipment damage.

Table 4-1 Recommended maintenance program

Period	Item	Check point	Remarks
3 to 6 months	Exposed nuts and bolts on scanner unit	Check for corroded or loosened nuts and bolts. If necessary, clean and repaint them thickly. Replace them if heavily corroded.	Sealing compound may be used instead of paint. Apply a small amount of grease between nuts and bolts for easy removal in future.
	scanner radiator	Check for dirt and cracks on radiator surface. Thick dirt should be wiped off with soft cloth dampened with fresh water. If a crack is found, apply a slight amount of sealing compound or adhesive as a temporary remedy, then call for repair.	Do not use plastic solvent (acetone) for cleaning. If you need to remove ice from antenna unit, use a wooden hammer or plastic head hammer. Crack on the unit may cause water ingress, causing serious damages to internal circuits.
6 months to 1 year	Display unit connectors	Check for tight connection and corrosion.	If corroded, contact your dealer for replacement.

4.3 Troubleshooting

Table 4-2 contains simple troubleshooting procedures which you can follow to try to restore normal operation. If you cannot restore normal operation, do not attempt to check inside any unit of the radar system. Any repair work is best left to a qualified technician.

Table 4-2 Troubleshooting table

If...	**But...**	**Then...**
you pressed the [POWER] key to turn on the radar	the control panel does not light	• try adjusting the control panel back-lighting on the OTHERS menu. • battery may have discharged. • check fuse in power cable.
	nothing appears on the display or display contrast is poor	• try adjusting the brilliance.
	characters are distorted	• request service.
the radar has warmed up and you pressed the [TX] key to transmit	the scanner does not rotate	• the problem may be in scanner unit. Request service.
	characters and indications are abnormal	• have a qualified technician check the set.
you have adjusted the gain with A/C RAIN and A/C SEA off	neither noise nor targets appear (indications and markers do)	• check signal cable for damage.
	neither indications nor markers appear (noise and targets do)	• check signal cable for damage.
	the sweep (radial line sweeping around the display) is not synchronized with scanner rotation	• the problem may be in the scanner unit. Request service.
	there is no change in sensitivity	• request service.
a key is pressed	nothing happens	• key may be faulty. Request service.

4.4 Life Expectancy of Magnetron

The following table shows the life expectancy of the magnetrons.

Table 4-3 Life expectancy of magnetrons

Magnetron Type	Code No.	Life expectancy
MG5248	000-116-121	2,000 - 3,000 hours (Including stand-by)
E3571	000-137-529	

SPECIFICATIONS OF MARINE RADAR
MODEL 1761 MARK-3

1. GENERAL

1.1. Indication System PPI Daylight display, raster scan, 8 tones in monochrome

1.2. Range, Pulselength (PL) & Pulse Repetition Rate (PRR)

		Range (nautical miles)													
PL	PRR	0.125	0.25	0.5	0.75	1.5	2	3	4	6	8	12	16	24	36	48
SP	2100 Hz	0.08 μs														
MP	1200 Hz					0.3 μs										
LP	600 Hz								0.8 μs							

1.3. Range Resolution 41 m

1.4. Bearing Discrimination 2.9º

1.5. Minimum Range 39 m (0.25 NM range)

1.6. Bearing Accuracy Within 1º

1.7. Range Ring Accuracy 0.9 % of range or 8 m, whichever is the greater

2. ANTENNA UNIT

2.1. Radiator Slotted waveguide array

2.2. Polarization Horizontal

2.3. Antenna Rotation Speed 24 rpm or 48 rpm nominal

2.4. Radiator Length 100 cm (XN-10A)

2.5. Horizontal Beamwidth 2.4°

2.6. Vertical Beamwidth 27°

2.7. Sidelobe Attenuation Within ±20° of main-lobe: less than -24 dB
Outside ±20° of main-lobe: less than -30 dB

3. TRANSCEIVER MODULE

3.1. Frequency 9410 MHz ±30MHz (X band)

3.2. Modulation P0N

3.3. Peak Output Power 4 kW nominal

3.4. Modulator FET Switching Method

3.5. Intermediate Frequency 60 MHz

3.6. Tuning Automatic

3.7. Receiver Front End MIC (Microwave IC)

3.8. Bandwidth Tx pulselength 0.08 μs and 0.3 μs: 7 MHz
Tx pulselength 0.8 μs: 3 MHz

3.9. Duplexer Circulator with diode limiter

4. DISPLAY UNIT

4.1. Indication System — PPI Daylight display, raster scan, 8 tones in monochrome

4.2. Picture Tube — 7 inch rectangular monochrome CRT
Effective display area more than 100 mm

4.3. Range, Range Interval, Number of Rings

Range (NM)	0.25	0.5	0.75	1	1.5	2	3	4	6	8	12	16	24	48
Ring Interval (NM)	0.125	0.125	0.25	0.25	0.5	0.5	1	1	2	2	3	4	6	12
Number of Rings	2	4	3	4	3	4	3	4	3	4	4	4	4	4

4.1. Markers — Heading Line, Bearing Scale, Range Rings,
Variable Range Marker (VRM),
Electric Bearing Line (EBL), Tuning Bar, Cursor, Alarm Zone,
Waypoint Mark (navigation input required),
North Mark (heading sensor input required)

4.2. Alphanumeric Indications — Range, Range Ring Interval, Interference Rejection (IR),
Stand-by (ST-BY), Radar Alarm (G(IN), G(OUT), G(ACKN)),
Range, Bearing and Latitude/Longitude of Cursor,
Echo Stretch (ES), Echo Plot (PLOT), Plot Elapsed Time,
Navigation Data (navigation input required),
Heading (HDC, heading sensor input required)

4.3. Input Data — NMEA0183 (Ver.1.5/2.0), current loop

Own ship's position: GGA>RMA>RMC>GLL (accept GLL in NMEA Version1.5 only)
Speed: RMA>RMC>VTG>VHW
Heading (True): HDT>HDG*1>HDM*1>VHW>VHW*1
Heading (Magnetic): HDM>HDG*1>HDT*1>VHW>VHW*1
Course (True): RMA>RMC>VTG
Course (Magnetic): VTG>RMC>RMA
Waypoint (Range, Bearing): RMB>BWC>BWR
Loran time difference: RMA>GLC>GTD
*1: calculated by magnetic drift.

4.4. Output Data — NMEA 0183 (Version 1.5/2.0), RS-422

5. ENVIRONMENTAL CONDITION

5.1. Ambient Temperature — Antenna Unit: -25°C to +70°C
Display Unit: -15°C to +55°C

5.2. Relative Humidity — 95 % or less at +40°C

5.3. Waterproofing — Antenna Unit: IPX6
Display Unit: IPX4

6. POWER SUPPLY & POWER CONSUMPTION

6.1. Power Supply — 12-32 VDC (10.2 to 40.0 VDC), 58 W approx.

6.2. Voltage and Current — XN-10A (24rpm): 12 VDC: 4.5 A, 24 VDC: 2.0 A, 32 VDC: 2.0 A

6.3. Power Consumption — XN-10A (24rpm): 70 W to 90 W (100 kt)

7. COATING COLOR

7.1.	Display Unit	Panel: N3.0, Chassis: 2.5GY5/1.5
7.2.	Antenna Unit	N9.5

8. COMPASS SAFE DISTANCE

8.1.	Display Unit	Standard: 0.50 m	Steering: 0.40 m
8.2.	Antenna Unit	Standard: 1.00 m	Steering: 0.75 m

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